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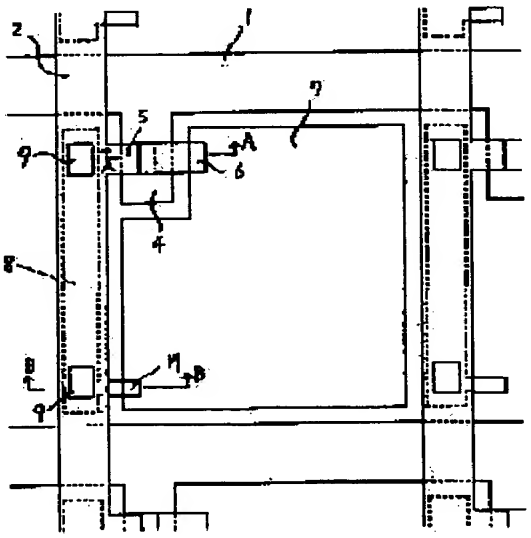
(54) ACTIVE MATRAIX TYPE SUBSTRATE

(57)Abstract:
PURPOSE: To easily inspect and correct a pixel defect even after the substrate is assembled in a display device.
CONSTITUTION: A branch part 14 which branches off from an auxiliary source bus electric conductor 8 has a part superposed with a pixel electrode 7. The superposed part is irradiated with the light energy of laser light, etc., and then a spot-shaped hole is bored in the superposed part. This hole electrically connects the auxiliary source bus electric conductor 8 to the pixel electrode 7 and than a source bus electric conductor 2 is electrically connected to the pixel electrode. 7 At the superposed part irradiated with the light energy, the branch part branching off from the pixel electrode may be made to superpose with the auxiliary source bus electric conductor 8.



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CLAIMS

[Claim(s)]

[Claim 1] An insulating substrate, and the scanning line and the signal line which were wired in all directions on this substrate, The insulator layer prepared between this scanning line and this signal line, and the scan branch line which branched from this scanning line, Have the switching element formed in the point of this scan branch line, and the picture element electrode connected with this signal line by this switching element, and signal-line parts other than the superposition section with this scanning line are received. In the active-matrix mold substrate by which opposite arrangement of the connectionless auxiliary signal line was electrically carried out in between on both sides of this insulator layer, and this signal line and this auxiliary signal line were electrically connected with this scanning line through the contact hole established in the insulator layer The active-matrix mold substrate with which the branch which branches from this auxiliary signal line and is superimposed on this picture element electrode to the picture element electrode electrically connected with the signal line which counters this auxiliary signal line by this switching element was formed.

[Claim 2] An insulating substrate, and the scanning line and the signal line which were wired in all directions on this substrate, The insulator layer prepared between this scanning line and this signal line, and the scan branch line which branched from this scanning line, Have the switching element formed in the point of this scan branch line, and the picture element electrode connected with this signal line by this switching element, and signal-line parts other than the superposition section with this scanning line are received. In the active-matrix mold substrate by which opposite arrangement of the connectionless auxiliary signal line was electrically carried out in between on both sides of this insulator layer, and this signal line and this auxiliary signal line were electrically connected with this scanning line through the contact hole established in the insulator layer The active-matrix mold substrate with which the crevice was formed so that it might branch from the picture element electrode electrically connected with the signal line which counters this auxiliary signal line by this switching element, and the branch superimposed to this auxiliary signal line might be formed and this branch might not be contacted at this signal line.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention

relates to the active-matrix substrate which arranges especially a picture element electrode in the shape of a matrix, and performs a high density display about the indicating equipment which performs a display by impressing a driving signal to the picture element electrode for a display through a switching element.

[0002]

[Description of the Prior Art] A display pattern is formed on a screen by conventionally carrying out selection actuation of the picture element electrode arranged in the shape of a matrix in a liquid crystal display, EL display, a plasma display, etc. An electrical potential difference is impressed between the selected picture element electrode and the counterelectrode which carried out opposite arrangement at this, and the optical modulation of display media, such as liquid crystal which intervenes among these electrodes, is performed. This optical modulation is checked by looking as a display pattern.

[0003] As an actuation method of a picture element electrode, the picture element electrode with which each became independent is arranged, and the active-matrix actuation method which connects and drives a switching element to each of this picture element electrode is learned. Moreover, generally as a switching element which carries out selection actuation of the picture element electrode, a TFT (thin film transistor) component, an MIM (metal-insulator layer-metal) component, an MOS transistor component, diode, a varistor, etc. are known. The display of high contrast is possible for a active-matrix actuation method, for example, it is put in practical use by the liquid crystal television, the word processor, the terminal display of a computer, etc.

[0004] The top view of an example of the active-matrix substrate used for the conventional active-matrix mold indicating equipment at drawing 7 is shown. This active-matrix substrate goes to the gate bus wiring 1 mutually arranged by parallel direct, and the source bus wiring 2 is arranged. Gate dielectric film is intervened in between, the auxiliary source bus wiring 8 is arranged by the lower layer of the source bus wiring 2, and the source bus wiring 2 and the auxiliary source bus wiring 8 are electrically connected to it by the contact hole 9 established in said gate dielectric film. The picture element electrode 7 is arranged on each field surrounded by the gate bus wiring 1 of two, and the two source bus wiring 2. On the gate branch 4 which carried out projection formation near the intersection of the gate bus wiring 1 and the source bus wiring 2, TFT which functions as a switching element is formed by using this gate branch 4 as a gate electrode. The drain electrode 6 of TFT is connected as electrically as the

picture element electrode 7. The branch line 5 which branched from the source pass wiring 2 is connected to the source electrode of TFT.

[0005]

[Problem(s) to be Solved by the Invention] When displaying high density using the display which has such a active-matrix substrate, it is necessary to arrange very many the picture element electrodes 7 and TFT(s). However, TFT may be formed as a malfunction component, when it creates on a substrate. The picture element electrode connected with such a defect component produces the point defect which does not contribute to a display. Since an electrical potential difference required between a picture element electrode and a counterelectrode is not impressed, these point defects are produced. Such a defect appears as the luminescent spot in the normally white mode from which the permeability of light serves as max, when the electrical potential difference impressed between a picture element electrode and a counterelectrode is 0V, and when this electrical potential difference is 0V, he appears as a sunspot in the normally black mode in which the permeability of light serves as the minimum.

[0006] Such a defect is correctable by performing laser trimming etc. However, since this defective correction is made in the state of the substrate before assembling a display, a picture element defect must be detected in the state of a substrate. The measuring device of the high degree of accuracy which measures the electrical characteristics of all picture element electrodes is needed for this detection. Therefore, in a large display module with much number of picture elements, the actual condition cannot make substantially defective correction in the substrate condition which used laser light in respect of mass production nature and cost etc.

[0007] This invention is made that this technical problem should be solved, also after assembling it to a display, it can inspect a picture element defect easily, and it aims at offering the active-matrix mold substrate which can correct.

[0008]

[Means for Solving the Problem] The scanning line and the signal line with which the active-matrix mold substrate of this invention was wired in all directions on the insulating substrate and this substrate, The insulator layer prepared between this scanning line and this signal line, and the scan branch line which branched from this scanning line, Have the switching element formed in the point of this scan branch line, and the picture element electrode connected with this signal line by this switching element, and signal-line parts other than the superposition section with this scanning line are received. In the active-matrix

mold substrate by which opposite arrangement of the connectionless auxiliary signal line was electrically carried out in between on both sides of this insulator layer, and this signal line and this auxiliary signal line were electrically connected with this scanning line through the contact hole established in the insulator layer The branch which branches from this auxiliary signal line and is superimposed on this picture element electrode is formed to the picture element electrode electrically connected with the signal line which counters this auxiliary signal line by this switching element, and the above-mentioned object is attained by that.

[0009] Moreover, the active-matrix mold substrate of this invention An insulating substrate, and the scanning line and the signal line which were wired in all directions on this substrate, The insulator layer prepared between this scanning line and this signal line, and the scan branch line which branched from this scanning line, Have the switching element formed in the point of this scan branch line, and the picture element electrode connected with this signal line by this switching element, and signal-line parts other than the superposition section with this scanning line are received. In the active-matrix mold substrate by which opposite arrangement of the connectionless auxiliary signal line was electrically carried out in between on both sides of this insulator layer, and this signal line and this auxiliary signal line were electrically connected with this scanning line through the contact hole established in the insulator layer The crevice is formed so that it may branch from the picture element electrode electrically connected with the signal line which counters this auxiliary signal line by this switching element, and the branch superimposed to this auxiliary signal line may be formed and this branch may not be contacted at this signal line, and the above-mentioned object is attained by that.

[0010]

[Function] If the branch which branched from the auxiliary signal line if it was in claim 1 has the part superimposed on a picture element electrode and is in claim 2, it has the part which the branch which branched from the picture element electrode superimposes on an auxiliary signal line.

[0011] If light energies, such as a laser beam, are irradiated at an above-mentioned superposition part, a hole will open in the shape of a spot into a superposition part. By formation of this hole, an auxiliary signal line and a picture element electrode are connected electrically, and a signal line and a picture element electrode are connected electrically.

[0012]

[Example] Below, the example of this

invention is explained.

[0013] The top view of the active-matrix mold substrate of this invention is shown in drawing 1 . The sectional view of the TFT section which met drawing 2 at the A-A line in drawing 1 is shown, and the sectional view which met drawing 3 at the B-B line in drawing 1 is shown. The gate bus wiring 1 and the source bus wiring 2 are wired in the shape of a grid on the glass substrate 17 whose active-matrix mold substrate of this example is an insulating substrate, and the picture element electrode 7 is formed in the field of the shape of a rectangle surrounded with both bus wiring 1 and 2. In the gate bus wiring 1, the gate electrode 4 which projects towards the picture element electrode 7 branches, and TFT is formed there as a switching element. Moreover, under the source bus wiring 2 except an intersection with the gate bus wiring 1, the auxiliary source bus wiring 8 exists through gate dielectric film 10. For this auxiliary source bus wiring 8, the branch 14 which projects even in the lower part of the picture element electrode 7 has branched. Furthermore, the source bus wiring 2 and the auxiliary source bus wiring 8 are electrically connected through the contact hole 9 formed by etching gate dielectric film 10.

[0014] As TFT mentioned above is shown in drawing 2 , it is the upper part of the gate electrode 4, and the channel layer 11 is formed on gate dielectric film 10, and the etching stopper 18 is formed on the channel layer 11. Furthermore, on the channel layer 11, it is divided by two with the etching stopper 18, and the contact layers 12 and 13 are formed, it applies on gate dielectric film 10 from on the contact layer 12, and the source electrode 5 is formed, it applies on gate dielectric film 10 from on the contact layer 13, and the drain electrode 6 is formed. The protective coat 16 is formed on the glass substrate 17 of this condition, and, thereby, TFT is constituted.

[0015] Next, the detailed configuration of this active-matrix mold substrate is explained according to a fabrication sequence.

[0016] As an insulating substrate, the glass substrate 17 was used by this example. Moreover, the structure which forms the insulator layer of Ta2O5 grade as base coat film is also possible. a glass substrate 17 top -- low [, such as aluminum, Mo, and Ta,] -- the auxiliary source bus wiring 8 is formed by carrying out the laminating of the conductor [****] using the sputtering method, and carrying out patterning of this. As auxiliary source bus wiring 8, aluminum was used by this example.

[0017] Next, the gate bus wiring 1 is formed by carrying out the laminating of monolayers or such multilevel metal, such as Ta, Ti, aluminum, and Cr, using the sputtering method similarly, and

carrying out patterning of this. As gate bus wiring 1, Ta was used by this example. When forming this auxiliary source bus wiring 8 simultaneously with the same ingredient as the gate bus wiring 1 at this time, the auxiliary source bus wiring 8 can be formed without increasing a manufacture process.

[0018] Next, the laminating of the insulator layer 10 is carried out on the gate bus wiring 1. In this example, the 3000A laminating of the SiNx film was carried out, using a plasma-CVD method as this insulator layer 10. Moreover, it is good also as structure which anodizes the gate bus wiring 1 and raises insulation more.

[0019] Then, it continues on an insulator layer 10 and the laminating of the intrinsic-semiconductor amorphous silicon layer (a-Si (i)) used as the channel layer 11 and the SiNx layer used as the etching stopper 18 is carried out using 300A and a 2000A plasma-CVD method, respectively. And patterning of the SiNx used as an etching stopper is carried out, and it forms the etching stopper 18.

[0020] Next, the 800A laminating of the n+ mold amorphous silicon layer (a-Si (n+)) which added P (Lynn) is carried out to an amorphous silicon using a plasma-CVD method, and the contact layers 12 and 13 are formed. These contact layers 12 and 13 are for making good ohmic contact between the channel layer 11 and the source electrode 5 and between the channel layer 11 and the drain electrode 6. Then, patterning is simultaneously performed to an intrinsic-semiconductor amorphous silicon layer and n+ mold amorphous silicon layer, and the channel layer 11 and the contact layers 12 and 13 are formed.

[0021] Next, the contact hole 9 for connecting electrically the source bus wiring 2 and the auxiliary source bus wiring 8 to the insulator layer 10 on the auxiliary source bus wiring 8 is formed by etching. This contact hole 9 is not cared about as structure which it forms in the ends of the auxiliary source bus wiring 8 like drawing 1 , and also is formed on [whole] the auxiliary source bus wiring 8.

[0022] Next, the laminating of the metal layers, such as Ti, aluminum, Cr, and Mo, is carried out by the sputtering method, patterning is performed, and the source bus wiring 2, the source electrode 5, and the drain electrode 6 are formed. By this example, Ti was used for these wiring 2 and electrodes 5 and 6. At this time, the structure of leaving the metal membrane piece used also for the superposition part of the auxiliary source bus wiring 8 and the picture element electrode 7 formed in a degree source bus wiring 2 grade being formed may be taken.

[0023] Next, the laminating of the ITO used as the picture element electrode 7 and an addition capacity electrode is carried out by the sputtering method,

patterning is performed, and the picture element electrode 7 is formed. Some picture element electrodes 7 are superimposed on the drain electrode 6. At this time, the structure of leaving ITO also on the source bus wiring 2 may be taken.

[0024] Furthermore, the laminating of the protective coat 16 which consists of SiNx is carried out the whole surface on the substrate in which TFT and the picture element electrode 7 were formed. A protective coat 16 may be made into the aperture aperture structure where the center section of the picture element electrode 7 was removed.

[0025] Therefore, in the active-matrix mold substrate produced as mentioned above, as shown in drawing 3 , the auxiliary source bus wiring 8 is electrically connected with the source bus wiring 2 through the contact hole 9 of an insulator layer 10. Moreover, the branch 14 of the auxiliary source bus wiring 8 is arranged even in the bottom of the picture element electrode 7. It is possible for this to correct a defective picture element by laser in the active-matrix mold substrate of this example.

[0026] Below, the procedure of the defective picture element correction in this example is shown.

[0027] First, opposite arrangement of the opposite substrate which has a counterelectrode is carried out to the TFT active-matrix mold substrate produced as mentioned above, liquid crystal is enclosed among both substrates, and a display is produced. In this condition, driver voltage is impressed to all the picture element electrodes 7 through TFT from the gate bus wiring 1 and the source bus wiring 2, and viewing detects a picture element defect. When TFT is poor or leakage current weak between the source bus wiring 2 and the picture element electrode 7 has occurred at this time, a picture element defect arises. A different color from a good part is presented in the part which the picture element defect produced.

[0028] Thus, if the location of a picture element defect is decided, after removing said inspection fixture, it will correct as follows. Drawing 4 is the enlarged drawing showing the branch 14 which branched from the auxiliary source bus wiring 8 of drawing 1 . Light energy is irradiated at the laser correction section 15 of a graphic display. Thereby, the branch 14 and the picture element electrode 7 of the auxiliary source bus wiring 8 are connected electrically. In this example, YAG laser light (wavelength of 1064nm) was used as light energy.

[0029] The sectional view after the laser correction which met drawing 5 at the B-B line of drawing 1 is shown. Like a graphic display, since the video signal from the source bus wiring 2 is always impressed, this picture element electrode 7 does not function on the corrected

picture element electrode 7 of a defect normally. However, the picture element displayed with this corrected picture element electrode will perform the display equivalent to the actual value of the video signal impressed to the source bus wiring 2 among this one period, if it lets one period of a scan signal pass. Therefore, this picture element displays average brightness of the picture element which does not serve as the perfect luminescent spot or a perfect sunspot, and is located in a line along with a signal line. Therefore, this picture element is corrected as a picture element defect which is very hard to distinguish.

[0030] The active-matrix mold substrate applied to other examples of this invention at drawing 6 is shown. At this example, without forming a branch in the auxiliary source bus wiring 8, crevice 2a was prepared in the source bus wiring 2, and the structure which forms the superposition section (hatching shows) with the picture element electrode 7 on the auxiliary source bus wiring 8 is taken by forming the branch 19 which enters into the picture element electrode 7 at said crevice 2a. Correction of a defective picture element electrode is made on the above-mentioned superposition section of the auxiliary source bus wiring 8 and the picture element electrode 7 by irradiating a laser beam like said example.

[0031]

[Effect of the Invention] While a picture element defect is easily detectable even if it is after producing a display if the active-matrix mold substrate of this invention is used, it is correctable so that it may not be conspicuous in a picture element defect. Therefore, according to this invention, a display can be produced by the high yield and it can contribute to cost lowering of a display.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The top view showing one example of the active-matrix mold substrate of this invention.

[Drawing 2] The sectional view of the TFT section which met the A-A line of drawing 1 .

[Drawing 3] The sectional view which met the B-B line of drawing 1 .

[Drawing 4] An about 14 branch [of the auxiliary source bus wiring 8 of drawing 1] enlarged drawing.

[Drawing 5] The sectional view after being the part which met the B-B line of drawing 1 and correcting a picture element defect.

[Drawing 6] The top view showing the active-matrix mold substrate concerning other examples of this invention.

[Drawing 7] The conventional example of a active-matrix mold substrate is shown.

[Description of Notations]

1 Gate Bus Wiring

2 Source Bus Wiring

4 Gate Electrode
5 Source Electrode
6 Drain Electrode
7 Picture Element Electrode
8 Auxiliary Source Bus Wiring
9 Contact Hole
10 Insulator Layer
11 Channel Layer
12 Contact Layer
13 Contact Layer
14 Branch
15 Laser Correction Section
16 Protective Coat
17 Glass Substrate
18 Etching Stopper
19 Branch